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Evaluation of extremity and pelvis traumas admitted to the emergency department before and during the pandemic; with laboratory, embolism and mortality data

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ABSTRACT

Aim: The purpose of this study was to determine the forms of trauma, demographic features, embolism status and mortality of patients who presented to the emergency department due to extremity and pelvis trauma before and during the pandemic period.

Material and Method: This retrospective study included 319 patients, who presented to the emergency department due to trauma between January 1, 2019, and December 31, 2020. The associations between embolism and mortality after trauma, as well as COVID-19, were investigated.

Results: The mean age of the 319 patients was 55.11±19.02 years, the distribution was 19-90 years and 133 (41.7%) were women. It was determined that 171 (53.7%) of the trauma patients were in the pre-pandemic period and 148(46.3%) were in the pandemic period. Embolism was detected in 19 (11.1%) cases before the pandemic and in 35 (23.6%) cases during the pandemic (p=0.003). Pre-pandemic mortality was observed in 10(5.8%) cases, and in pandemic 21 (14.2%) cases (p=0.010). While embolism was present in 22 (71%) cases in the mortality group, it was not observed in 9(29%) cases (p=0.001).

Conclusion: COVID-19 infection and pandemic can adversely affect the incidence of trauma, embolism and mortality. Embolism and mortality rates have increased significantly with the effects of COVID-19 during the pandemic period.

Keywords: COVID-19, embolism, emergency department, extremity traumas, mortality

INTRODUCTION

The coronavirus epidemic started at the end of 2019 and continued throughout 2020 (1). Admissions to pandemic hospitals were affected by many different parameters during this period (2). Turkey's first official case was detected in March 2020; and from that date to December 2020, more than 2 million cases were diagnosed with COVID-19 (3). Patients may develop varying degrees of respiratory failure, cardiovascular complications, secondary infections, thromboembolic events, and inflammatory complications.

Trauma affects all age groups, especially young people, and can cause serious labor loss. All kinds of trauma patients apply to emergency services, and extremity and pelvis traumas constitute a substantial group among these applications. Approximately 33 million musculoskeletal traumas occur each year, 20 million of which are fractures. Pelvic trauma occurs in 3% of skeletal injuries and is associated with serious complications (4-6). Both these traumas and the complications that may develop after them are very important in terms of morbidity and mortality.

Due to coronavirus disease 2019 (COVID-19), the effects of the pandemic are now being studied in every medical field. Although the infectious agent and pandemic had no direct impact on trauma, they had indirect effects.

It is already known that embolism poses an increased risk in trauma patients. While planning the study, we wondered how the incidence of extremity and pelvis trauma, which is a frequent reason for admission to the emergency department, is affected by the pandemic process, and how the history of COVID-19 positivity affects the development of embolism and mortality risks in these trauma cases.

This study aimed to compare the incidence of emergency admission, embolism development, morbidity and mortality in patients with extremity and pelvic trauma before and after the pandemic. It is anticipated to

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contribute to the literature by determining the effects of the COVID-19 pandemic due to social closures and the increased tendency to thrombosis caused by the infection that causes it, on the distribution of extremity and pelvic trauma cases and the subsequent complication process.

MATERIAL AND METHOD

Ethics

The study was carried out with the permission of Medipol University Noninvasive Clinical Researches Ethics Committee (Date: 14.10.2021, Decision No: 1001). All procedures complied with the ethical norms of the institutional and national committees responsible for human experiments and the Helsinki Declaration. Due to the retrospective design of the investigation, no written informed permission forms were acquired from patients. The corresponding author certifies, on behalf of all authors, that there are no conflicts of interest.

Study Design and Population

This retrospective analysis included 319 individuals over the age of 18 who accessed emergency treatment for trauma between January 1, 2019 and December 31, 2020. The first year was defined as the pre-pandemic period, and the following year as the pandemic period. Patients with upper extremity, lower extremity and pelvis trauma who applied to our hospital during these time periods were screened. Among the cases, those over the age of 18, who applied with a history of falling from a height (>1meter) , gunshot injury and traffic accident were included in the study. In this way, Age, gender, laboratory, trauma localization, trauma type, embolism and mortality data were evaluated. Minor home and play accidents, related incisions, additional thorax, neck, head and abdominal traumas were excluded from the study as they may affect the outcome of the study with other complications. Apart from these, patients who did not have COVID-19 disease, whose polymerase chain reaction test was negative, or who had 3 months past the COVID-19 infection disease during the pandemic period were not included in the research. The reason for this was to see the direct effects of COVID-19 infection by excluding cases who did not have COVID-19 infection during the pandemic period. While the effect of the pandemic was evaluated in the comparison of the pandemic process and the pre-pandemic period in terms of the admissions of trauma patients, the effect of COVID-19 on other laboratory, embolism and mortality results was evaluated.

Patients who applied to the emergency department due to fall, traffic accident, and gunshot injury, had upper extremity, lower extremity, and pelvis trauma, and had hemogram, biochemistry, D-Dimer, C-reactive protein (CRP), and sedimentation tests studied in the emergency clinic were included. Patients with missing data on the type of injury, clinical, laboratory or imaging findings in the hospital data recording system were excluded from the study.

The patients were divided into two groups as pre-pandemic and pandemic periods. According to the trauma types, three groups were determined as falling from a height, traffic accident, and gunshot injury. For upper extremity trauma patients with the following forms of injury were included; " clavicle, proximal humerus, distal humerus, humerus shaft, radius head and neck, monteggia, Radius + ulna shaft, colles, hand bone, and multiple upper extremity fractures". For pelvic traumas, following forms of injury were included " sacrum, iliac wing, acetabulum, symphysis pubis, and common pelvis fracture". For lower extremity traumas following forms of injury were included as "proximal femur, distal femur, femur shaft, patella, proximal tibia, tibia shaft, tibia-fibula, fibula, distal tibia, foot bone, multiple lower extremity fractures". In addition, two groups were determined according to post-traumatic mortality and development of embolism.

In the study, individuals with excellent and moderate general conditions were reviewed in the trauma emergency unit, while those with bad coma scores and awareness levels were evaluated in the emergency critical resuscitation room. The proper care was initiated for individuals who required fluid and blood resuscitation, and forensic forms of these patients were made and administered to those without tetanus vaccine. All patients were logged into the hospital's automation system and patient files. Our hospital's registration structure incorporates diagnoses, admission dates, contact information, and demographic, clinical, and laboratory data.

Statistical Analysis

This study's data were analyzed using the SPSS 20 (SPSS Inc., Chicago, IL, USA) software platform. For continuous variables, descriptive statistics were reported as mean±standard deviation or median (minimum-maximum), and for nominal variables, as number of cases and percentage (%). To investigate the differences between the groups, the Mann-Whitney U Test and Kruskal-Wallis Test were utilized. Chi-square analysis was used to investigate the associations between nominal variable groupings. The linear relationship between the variables was analyzed using a Pearson correlation. A boxplot study of age, mortality, trauma, pre-pandemic, and pandemic periods was undertaken. In analyzing the data, values below the significance threshold of 0.05 were determined statistically significant.

RESULTS

The mean age of the 319 patients who applied was 55.11±19.02 years; distribution was 19-90 years, 133(41.7%) were women. Of the trauma patients, 171(52%) were admitted before the pandemic, and 158(48%) during the pandemic period. Age (p=0.293) and gender (p=0.262) were not associated with pandemic and pre-pandemic referrals. Blood glucose 142.99±55.18mg/dL (p=0.028), white blood cell (WBC) 12.70±3.79 x103/UL (p=0.001), hemoglobin 13.04±2.51 g/dL (p=0.001), and hematocrit %39.33±7.34 (p=0.001), varied significantly between the admission periods. Whereas, platelet, D-dimer, sedimentation, and CRP groups were found to be significant (p=0.001). Evaluation of the pre-pandemic and pandemic groups with variables; 68 (39.8%) of 171 patients before the pandemic and 65 (43.9%) of 148 patients during the pandemic period were women. Falls from height and traffic accidents were equal to 145 cases in both groups, and firearm injuries were detected in 29 cases. Gunshot injuries were also close to each other, with 13 and 16 cases. Of all cases, 272 (85.3%) had upper extremity, 123 (38.6%) pelvis, 294 (92.2%) lower extremity trauma pathology. There was no significant change in injury localizations before and during the pandemic. Among post-traumatic groups, 19 (11.1%) cases of embolism were identified prior to the pre-pandemic, compared to 35 (23.6%) during the pandemic (p=0.003). Before the pandemic, mortality was identified in 10 (5.6%) individuals, and in 21 (14.2%) during the pandemic (p=0.010, **Table 1**).

Table 1. Evaluation of age, gender, laboratory, trauma localization, trauma type, embolism and mortality data in pandemic and pre-pandemic periods.

	Period			
	All Patients	Pre-pandemic	Pandemic	p value
	mean±SD	mean±SD	mean±SD	
Age, year	55.11±19.02	54.26±17.89	56.10±20.28	0.293
Labaratory finding				
Glucose, mg/dL	142.99±55.18	135.32±41.09	151.86±66.98	0.028
WBC, $\times10^3$/UL	12.70±3.79	11.81±3.76	13.71±3.57	0.001
Hemoglobin, g/dL	13.04±2.51	13.72±2.25	12.26±2.57	0.001
Hemotocrit, %	39.33±7.34	41.27±6.63	37.10±7.51	0.001
Platelet, $\times10^3$/UL	251.40±77.02	276.03±67.03	222.95±78.21	0.001
D-dimer, ng/mL	394.05±185.33	344.05±153.41	451.83±202.03	0.001
Sedimentation, mm/h	28.84±20.29	22.20±11.93	36.51±24.02	0.001
CRP, mg/dL	19.24±23.47	13.48±15.97	25.88±28.52	0.001
	n(%)	n(%)	n(%)	
Gender				0.262
Female	133 (41.7)	68 (39.8)	65 (43.9)	
Male	186 (58.3)	103 (60.2)	83 (56.1)	
Trauma Type				0.594
Fall from height	145 (45.5)	78 (45.6)	67 (45.3)	
Traffic accident	145 (45.5)	80 (46.8)	65 (43.9)	
Gunshot injury	29 (9)	13 (7.6)	16 (10.8)	
Trauma Localization				
UE				0.843
No	47 (14.7)	28 (16.4)	19 (12.8)	
Yes	272 (85.3)	143 (83.6)	129 (87.2)	
PV				0.361
No	196 (61.4)	110 (64.4)	86 (58.1)	
Yes	123 (38.6)	61 (38.6)	62 (35.6)	
LE				0.718
No	25 (7.8)	15 (8.8)	10 (6.8)	
Yes	294 (92.2)	156 (91.2)	138 (93.2)	
Embolism				
No	265 (83.1)	152 (88.9)	113 (76.4)	0.003
Yes	54 (16.9)	19 (11.1)	35 (23.6)	
Mortality				0.010
No	288 (90.3)	161 (94.2)	127 (85.8)	
Yes	31 (9.7)	10 (5.8)	21 (14.2)	
TOTAL	319 (100)	171 (100)	148 (100)	

SD: Standard Deviation, WBC: White Blood Cell, CRP: C-reactive protein, UE: Upper Extremity, PV: Pelvis, LE: Lower Extremity, p:Statistical significance (<0.05)

While the mean age of the survival group was 52.59±17.63 years, it was 78.51±15.37 years in the mortality group (p=0.001). Twenty-one (67.7%) of 31 cases with mortality were male. When the mortality status of the pre-pandemic and pandemic groups is evaluated; while it was insignificant with gender, the mortality rate increased with increasing age. Glucose level, WBC, hemoglobin, hematocrit, platelet, D-dimer, sedimentation, and CRP values were associated with mortality (p= 0.001). Mortality was detected in 31 (9.7%) of 319 patients (p=0.001). While there were 16 (51.6%) mortality cases due to falling from a height and 15 (48.4%) mortality cases due to traffic accidents, there was no death due to firearm injuries. When mortality was evaluated according to the traumatic pathology region, it was seen that the region of pelvis and lower extremity traumas had a significant relationship with mortality (p=0.001). While there was no embolism in 9 (29%) cases with mortality, embolism was present in 22 (71%) cases (p=0.001, **Table 2**).

Table 2. Evaluation of age, gender, laboratory, trauma localization, trauma type, embolism and mortality data in pandemic and pre-pandemic periods.

	Mortality		
	No	Yes	p value
	mean±SD	mean±SD	
Age, year	52.59±17.63	78.51±15.37	0.001
Labaratory finding			
Glucose, mg/dL	137.22±45.64	196.66±95.11	0.001
WBC, $\times10^3$/UL	12.28±3.59	16.54±3.43	0.001
Hemoglobin, g/dL	13.40±2.22	9.68±2.53	0.001
Hematocrit, %	40.27±6.64	30.59±7.87	0.001
Platelet, $\times10^3$/UL	258.32±74.25	187.16±73.54	0.001
D-dimer, ng/mL	355.96±146.63	747.90±122.84	0.001
Sedimentation, mm/h	25.06±15.33	63.99±26.45	0.001
CRP, mg/dL	14.80±16.42	60.42±36.27	0.001
	n(%)	n(%)	
Gender			0.177
Female	123 (42.7)	10(32.3)	
Male	165(57.3)	21(67.7)	
Trauma Type			0.044
Fall from height	129(44.8)	16(51.6)	
Traffic accident	130(45.1)	15(48.4)	
Gunshot injury	29(10.1)	0(0)	
Trauma Localization			
UE			0.134
No	46(16)	1(3.2)	
Yes	242(84)	30(96.8)	
PV			0.001
No	195(67.7)	1(3.2)	
Yes	93(32.3)	30(96.8)	
LE			0.001
No	25(8.7)	0	
Yes	263(92.3)	31(100)	
Embolism			0.001
No	279(96.9)	9(29)	
Yes	9(3.1)	22(71)	
TOTAL	288(100)	31(100)	

SD: Standard Deviation, WBC: White Blood Cell, CRP: C-reactive protein, UE: Upper Extremity, PV: Pelvis, LE: Lower Extremity, p:Statistical significance (<0.05)

DISCUSSION

Understanding the epidemiology of trauma enables accurate estimation of morbidity and mortality. As a result, risk groups are identified, clinical treatment is facilitated, and trauma team coordination is facilitated. Fractures of the skeletal system and associated soft tissue changes are the most common type of injury in trauma patients. The emergency department's primary goals for extremity injuries are to define life-threatening, extremity-threatening injuries, to manage extremity injuries in conjunction with other injuries, to determine whether extremity injuries require surgical management, and to manage simple fractures, dislocations, and soft tissue injuries (7). Potentially life-threatening extremity injuries are mainly; active bleeding from major vessels, severe crush injuries, severe open fractures, proximal amputation and multiple proximal extremity fractures. Extremity-threatening extremity injuries are arterial injury or occlusion, compartment syndrome, open fracture, limited crush injuries, and joint dislocations. In addition, mortality is quite common due to complications that develop after trauma, not directly related to trauma (7).

Venous thromboembolism (VTE) is a clinicopathological event in which deep vein thrombosis (DVT) and pulmonary embolism (PE) occur together (8). The frequency of VTE after major trauma is between 10-60%, and the risk of VTE increases up to 13 times in trauma patients. It is a known fact that VTE and mortality rates are higher in patient groups who are being followed up in trauma and intensive care units as immobile compared to other patient groups (9).

The obtained data show that coagulopathy has an important place in the pathogenesis of COVID-19 infection. COVID-19 causes a tendency to thrombosis in both the venous and arterial systems with the activation of the coagulation system by several risk factors such as increased inflammation, platelet activation, endothelial dysfunction and stasis in the blood flow due to immobilization. Coagulopathy seems to be related to the severity of the disease, its pathogenesis is not yet known, and it is thought to occur as a result of a "thromboinflammation" process (10-12)

All this information encouraged us to evaluate the rates of admission to the emergency department, development of embolism, laboratory results and mortality rates of extremity and pelvis trauma cases of pre-pandemic and pandemic periods.

In the study of Öztürk et al. (13) on patients with upper extremity trauma, when the distribution of the cases according to gender and age was examined, it was seen that male patients (n=58) were more than female patients

(n=24) by 71%, and the age range of the patients was mostly between 14-44 years. The mean age was 30.6 years in the study of Srivastava et al. (14) and 32.4 years in the study of Helmi et al (15). Our study also consisted of patients who showed characteristics before and during the pandemic, with a mean age of 55 years and 58.3% male. The fact that the male population is high and they are more active has led to a higher number of male patients.

The elderly population's developmental pattern of trauma is distinct from that of the general population. Traffic accidents are the leading cause of general body trauma worldwide. Age is a risk factor for traffic accidents. The elderly's diminished reflexes and sensations are the primary contributors to the occurrence of such accidents. The most common cause of trauma in our country, accounting for 60-66 percent, is traffic accidents. This is followed by falls (20%), assault (8%), stab wounds (6-8%), and firearm injuries (4%) (16). In some studies, falls are the first cause of trauma in the elderly population, followed by motor vehicle accidents (17). While data were collected in our study, the most common cause of trauma was traffic accidents, followed by falls from height.

Although we evaluated trauma patients in pandemic and pre-pandemic period, we also evaluated the change in laboratory results of two groups in the study. Infection markers such as white blood cell (WBC), sedimentation and C-reactive protein (CRP) are expected to be high in cases of COVID-19, which is already an infectious process. Studies have also shown the relationship between these values and mortality (18). Other reported main laboratory parameters included decreased platelet, lymphocyte, total protein levels, and increased D-dimer, creatinine, and creatine kinase levels (19). Rostami et al. found a significant relationship between D-dimer levels and mortality in their study (20). Yalcin et al. reported the possibility of hereditary thrombophilia with prolonged or newly emerging D-dimer elevation in COVID-19 disease with mild-to-moderate symptoms (21). Similarly, in our study, WBC, CRP, and sedimentation values were found to be high and associated with mortality in the pandemic group. Also, D-dimer was found to be high in the pandemic group and was found to be significantly associated with mortality. We believe that the increase in embolism cases in the study may be correlated with this process.

It has been reported that 10% of deaths worldwide are due to trauma injuries. 3% of all deaths in Turkey occur due to trauma. Again, according to these data, the most common cause of death as a result of trauma is motor vehicle accidents, with 26% of these deaths occurring in young people between the ages of 20-35 and 74% in males (22). In the study of Başoğlu et al. (23) on a blunt multi-trauma patient group, the mortality rate was 16.2%. While the mortality rate was 25% in the study of Helmi et al. (15) on traffic accidents, it was 8.9% in the study of MacLeod et al. (24). Similarly, in the study of Wladis et al. (25), no statistically significant difference was found between the genders in terms of mortality rates. Mortality was found in 31 (9.7%) cases in our study. Mortality was observed in 10 (5.8%) patients in the pre-pandemic group and 21 (14.2%) patients during the pandemic period. Mortality cases in falls from height and traffic accidents were close to each other. Various studies show that the mortality rate in the elderly trauma population varies between 10% and 34% (26,27). 28% of all deaths due to trauma are cases over 65 years of age (26). In our study, the mean age of mortality group was 78 years and there was no significant difference between gender. As in similar studies, falls were detected in the first line of traumas over the age of 75.

COVID-19 has been noted for coagulopathy associated with an increased incidence of DVT and PE. As it is well known, immobility, inflammatory state, and changes in coagulation mechanisms cause DVT and PE (28). In a study of 388 COVID-19 patients in Italy, a thromboembolic event developed in 28 (7.7%) of all patients, 8 (27.6%) of intensive care patients, and 20 (6.4%) of service patients (28). An important factor that worsens the prognosis in COVID-19 cases is the increased probability of developing PE (29). In our study, although pulmonary embolism cases increased despite decreasing trauma numbers, it also seems to have contributed to a significant increase in mortality.

As a result, it is thought that pelvis and extremity traumas decreased numerically during the pandemic period, and this may be due to the decrease in trauma cases due to social restrictions. Despite the decreasing number of traumas, the increase in mortality rates and embolism detections during the pandemic can be explained by the negative contribution of COVID-19 to the process with coagulopathy.

When all these are evaluated, we can say that the pandemic has an indirect effect on the number of traumas to decrease numerically, but that the COVID-19 infection significantly increases the incidence of embolism and mortality by contributing to the thrombotic process with the mechanisms we mentioned. Therefore, although this is always a necessity, care should be taken in terms of embolism, especially in cases of trauma concurrent with COVID-19 infection, and the necessary prophylactic treatment process should be applied in this regard. In this respect, we think that embolism and related mortality will decrease if care is taken and foresighted and necessary prophylaxis is provided in these cases.

One of the study's limitations is that the data were collected retrospectively from a single center, and the data ranges for some patient groups were limited. Another limitation is the loss of patient information and follow-up data after treatment. To maintain a balance in the age and comorbidity distributions, patient selection close to these data points can also be considered a form of limitation.

CONCLUSION

In trauma patients, we can indicate that the presence of old age and COVID-19 infection increase the risk of pulmonary embolism and mortality. The fact that COVID-19 infection increases the risk of developing coagulopathy plays a role in this situation. Additionally, this can be explained by an unintentional reduction in the priority placed on trauma in the provision of health services during the pandemic period, as well as the elective prolongation of necessary procedures. We believe that numerous additional comprehensive studies are necessary to ascertain the pandemic's impact on health services and survival in terms of trauma and internal pathologies.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Medipol University Noninvasive Clinical Researches Ethics Committee (Date: 14.10.2021, Decision No: 1001).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version.

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